REMARKS

New claim 34 has been added. Accordingly, claims 2, 3, 14, 20 and 34 are pending. Clams 15-19 and 21-25 are withdrawn as being directed to a non-elected species. Applicants submit arguments for overcoming the rejections based on the prior art of record and respectfully submit that the present application is in condition for allowance.

Claim Rejections - 35 USC 103(a)

> *In the Office Action, the Examiner rejects claims 2, 3, 14 and 20 under 35 USC 103(a) as being obvious over the publication of Mathaudhu et al. titled "Progress in Consolidation of Amorphous Zr-based Powder into Bulk Metallic Glass" in view of U.S. Patent Application Publication No. 2003/0126804 A1 of Rosenflanz et al. in further view of the publication of Gu et al. titled "Structure of Shear Bands in Zirconium-Based Metallic Glasses Observed by Transmission Electron Microscopy".*

Applicants respectfully request reconsideration and removal of the above referenced rejection for the following reasons:

(i) Applicants respectfully submit that the Examiner has misinterpreted the disclosure relating to sputtering targets in U.S. Patent Application Publication No. 2003/0126804 A1 of Rosenflanz et al.;

(ii) Applicants respectfully submit that the Examiner has misinterpreted the disclosure concerning shear bands in the publications of Mathaudhu et al. and Gu et al. as it relates to the sputtering target of the present invention; and

(iii) Applicants respectfully submit that the inventors have advanced the art with respect to sputtering targets and methods of manufacture thereof, that the advancement is worthy of a receiving a patent, and that the claimed invention would not have been obvious to one of ordinary skill in the art based solely on the prior art of record.

(i) The Rosenflanz et al. Publication

The Rosenflanz et al. publication relates to "alumina-zirconia materials" (see Paragraph No. 0002 of Rosenflanz et al.). More specifically, the Rosenflanz publication relates to an amorphous material comprising Al_2O_3, ZrO_2 and a metal oxide other than Al_2O_3 and ZrO_2 (see Paragraph No. 0011 of Rosenflanz et al.).

Paragraph No. 0082 of Rosenflanz et al. discusses how the "raw materials" of the "metal oxide sources" can be made into "oxide amorphous materials and amorphous metals". For example, Paragraph No. 0082 of Rosenflanz et al. states that:

> "The raw materials can be ***melted and quenched*** using techniques and equipment known in the art for making oxide amorphous material and amorphous metals."

Paragraph No. 0083 of Rosenflanz et al. follows up the discussion of techniques for making amorphous materials started in Paragraph No. 0082 and discloses "other techniques". One of the disclosed "other" techniques is "vapor phase quenching" (e.g. sputtering). More specifically, Paragraph No. 0083 of Rosenflanz et al. states:

> "***Vapor phase quenching*** can be carried out, for example, by sputtering, wherein the ***metal alloys or metal oxide sources are formed into a sputtering target(s)*** which are used. The target is fixed at a predetermined position in a sputtering apparatus, and a substrate(s) to be coated is placed at a position opposing the target(s). Typical pressure of 10-3 torr of oxygen gas and Ar gas, discharge is generated between the target(s) and a substrate(s), and Ar or oxygen ions collide against the target to start reaction sputtering, thereby depositing ***a film of composition on*** the substrate."

In Paragraph No. 0083, the "raw materials" or "metal oxide sources" are sputtering targets, and the amorphous material produced by the raw materials is the "film" deposited on the substrate. Paragraph No. 0083 simply states that "the metal alloys or metal oxide sources are formed into a sputtering target(s)". <u>Paragraph No. 0083 of Rosenflanz et al. provides no disclosure of how the sputtering targets are made or any other information concerning the</u>

sputtering targets. Thus, one of ordinary skill in the art would conclude that these are conventional sputtering targets made by conventional melting and quenching techniques.

Paragraph No. 0083 also identifies "gas or centrifugal atomization" as an "other technique" for forming an amorphous material. Paragraph No. 0084 discloses further specifics of how a "gas atomization" technique can be used to form "substantially discrete, generally ellipsoidal amorphous material comprising particles (e.g. beads)". However, there is no disclosure provided by Rosenflanz et al. that the particles are used to make sputtering targets.

Turning to the Final Office Action, it states that:

> "Rosenflanz et al. ('804) disclose ***amorphous materials formed by gas atomization can be formed into sputtering targets*** (paragraph [0083], page 8)."

Applicants respectfully submit that this is an improper, inaccurate, and overly broad interpretation of the disclosure provided by the Rosenflanz et al. publication. Rosenflanz et al. state that amorphous materials (e.g. films) can be formed by sputtering (e.g. vapor phase quenching). In this case, the amorphous material formed is the thin film deposited on the substrate; the sputtering targets are merely the "source" of "raw material". In a separate disclosure, Rosenflanz et al. discloses forming amorphous materials (e.g. particles or beads) by gas atomization techniques; however, this is not in connection with the formation of sputtering targets.

Accordingly, Applicants respectfully request the Examiner to reconsider the disclosure provided by the Rosenflanz et al. publication. It discloses sputtering targets formed of "metal alloys or metal oxide sources". However, Rosenflanz et al. clearly fail to disclose that "amorphous materials formed by gas atomization can be formed into sputtering targets".

Turning to the obviousness rejection of the claims 2, 3, 14 and 20 of the present application, Mathaudhu et al. is cited as disclosing bulk metallic glass produced by consolidating

gas atomized powder. However, as readily admitted by the Examiner, Mathaudhu et al. fail to disclose a sputtering target, or a sputtering target made from such material. Thus, it clearly would not have been obvious to one of ordinary skill in the art using only routine skill and knowledge to make a sputtering target, the structure of a sputtering target, or anything in the nature of sputtering and targets used to form thin films, and certainly a high quality sputtering target suitable for forming films of complex shapes in the field of nanotechnology, based solely on the Mathaudhu et al. publication. Rather, one of ordinary skill in the art using only routine skill and knowledge would use conventional melting and quenching techniques.

In an attempt to overcome this deficiency of Mathaudhu et al., the Examiner reasons that since Rosenflanz et al. disclose "***amorphous materials formed by gas atomization can be formed into sputtering targets (paragraph [0083], page 8)***" and Mathaudhu et al. discloses an amorphous material, then it would be obvious to one of ordinary skill in the art to use the amorphous material disclosed by Mathaudhu et al. to form a sputtering target. However, as stated above, a close reading of Rosenflanz et al. clearly shows that Rosenflanz et al. fails to disclose a sputtering target produced of a sintered body of gas atomized powder. Similar to Mathaudhu et al., Rosenflanz et al. simply discloses that an amorphous material can be formed by gas atomization. Neither Mathaudhu et al. nor Rosenflanz et al. disclose a sputtering target made of a sintered body of gas atomized powder.

For this reason, Applicants respectfully submit that the above referenced obviousness rejection is flawed and that the rejection should be withdrawn. None of the prior art of record discloses a sputtering target having a sintered body structure of gas atomized powder.

Applicants respectfully request reconsideration and removal of the obviousness rejection of claims 2, 3, 17 and 20 for at least this reason.

(ii) The Gu et al. Publication and Shear Bands

Independent claim 2 of the present application requires the metallic glass sputtering target to have an average crystallite size of 1nm to 5nm. Thus, the **entire** sputtering target is required to have a fine and **uniform** crystal structure composed of nano crystallites. The structure according to the present invention is obtained without bending deformation or so called "shear bands" produced by bending. Rather, the metallic glass sputtering target of the present invention is produced using powder metallurgy techniques instead of conventional melting and quenching techniques. The powder metallurgy technique permits the entire body of the metallic glass sputtering target to be produced with an extremely fine and uniform crystal structure. Such a structure cannot be produced using conventional melting and quenching techniques.

The Examiner readily admits that Mathaudhu et al. and Rosenflanz et al. fail to disclose a sputtering target having an average crystallite size of 1nm to 5nm, or 1nm to 2nm (as required by dependent claim 3 of the present application.) In an attempt to overcome this deficiency of the cited references, Gu et al. is cited and relied upon in the above referenced obviousness rejection.

Turning to the Gu et al. publication, it is directed very specifically to an investigation of so-called "shear bands" produced in bulk metallic glass specimens by bending the specimens. (See page CC7.9.1 of the Gu et al. publication.) The metallic glasses of Gu et al. are not the same as that of Mathaudhu et al. (e.g. they are not produced by consolidating gas atomized powder). Rather, Gu et al. clearly state that their specimens are produced by conventional "arc-melting", "melt-spinning", or "suction casting" techniques. (See page CC7.9.2, second paragraph, of the Gu et al. publication.)

The specimens of Gu et al. are deformed by being bent along a sharp metal edge to a bending angle of about 150°. (See page CC7.9.2, second paragraph, of the Gu et al. publication.)

The bent specimens are partially flattened, and the shear bands produced as a result of the bending are examined. Gu et al. disclose that the shear bands have a "typical thickness of ... about 20nm." (See page CC7.9.2, third paragraph, of the Gu et al. publication.) Gu et al. state that particles in the region where the shear bands are closely spaced have an average size of 3nm. (See page CC7.9.2, last 5 lines, of the Gu et al. publication.)

Accordingly, the specimens produced by Gu et al. are not sputtering targets and do not have a fine and **uniform** crystal structure **throughout the entire body** of the specimen. Rather, the particles having an average size of 3nm are located only within narrow regions extending between "closely spaced" shear bands.

As stated above, the present invention is directed to a sputtering target in which the **entire** body has a fine and **uniform** crystal structure (e.g. an average crystallite size of 1nm to 5nm). Mathaudhu et al and Rosenflanz et al. fail to disclose, suggest or teach this limitation, and Gu et al. relate to arc-melting specimens having a fine crystal structure only within extremely narrow regions between "closely spaced" bands of shear produced via bending deformation.

Accordingly, Applicants respectfully submit that the above referenced obviousness rejection is flawed and that the rejection should be withdrawn. None of the prior art of record discloses a sputtering target having a fine structure (e.g. having an average crystallite size of 1nm to 5nm) uniformly throughout the **entire** body of the sputtering target and not just within bands of shear. Further, none of the prior art of record discloses a sputtering target having an average crystallite size of 1nm to 2nm as required by claim 3 of the present application (e.g. the "region" in Gu et al. only discloses an "average size of 3nm".)

Further, the Examiner combines Mathaudhu et al. with Gu et al. on the basis that Mathaudhu et al. discloses shear bands. However, Mathaudhu et al. merely disclose the use of

"Vickers hardness indentations" pressed into the material for purposes of determining the amorphous nature of the material. The "Vickers hardness indentations" are for analysis purposes only and are not for altering the structure of the specimen to create the "regions" of Gu et al. between closely spaced shear bands. Accordingly, Applicants respectfully request the Examiner to reconsider the arguments previously submitted by Applicants' with respect to the lack of any valid reason why one of skill in the art would think of combining the teachings of Gu et al. with the Mathaudhu et al. publication.

Applicants respectfully request reconsideration and removal of the obviousness rejection of claims 2, 3, 17 and 20 for at least this additional reason.

(iii) Combination Fails to Disclose the Present Invention

Independent claim 2 of the present application is directed to a metallic glass sputtering target having an average crystallite size of 1nm to 5nm formed from an amorphous material obtained by sintering gas atomized powder.

As stated in the present application on pages 1, line 30, to page 2, line 15, conventional methods of manufacturing bulk-shaped metallic glass uses molten metal subject to quenching. Also, see the present application on page 2, lines 23-25, which states that conventional bulk metallic glass produced by the quenching of molten metal has a relatively "coarse crystal structure and requires a high cost for its production, for the coating film to be used in nanoprocessing." In addition, see the present application on page 2, lines 14 -15, which state that the conventional manufacturing method is limited to producing targets of limited size.

Accordingly, the sputtering target of the present invention is produced using powder metallurgy techniques instead of conventional melting and quenching techniques. With this

technique, the **entire** sputtering target has an ultrafine and **uniform** crystal structure composed of nano crystallites. Such a fine and uniform structure cannot be produced using conventional melting and quenching techniques. In addition, the sputtering targets according to the present invention are less expensive to manufacture and can be produced in larger sizes relative to those produced by conventional melting and quenching processes.

Further, see the present application on page 8, lines 13-21, which states:

> "The sintered body prepared as above is processed into a prescribed shape … to obtain a target. ***The obtained sputtering target of the present invention has a nano-size ultrafine, uniform structure***. Further, the target of the present invention is characterized in that a target of 100mmϕ or more can be manufactured easily.
>
> When sputtering is performed with this target, a superior effect is yielded in that the uniformity of the film will become favorable, generation of arcings and particles can be suppressed, and quality of the sputtering deposition can be improved."

Accordingly, Applicants respectfully submit that the inventors have advanced the art with respect to the structure of metallic glass sputtering targets and methods of manufacture thereof and that their advancement is worthy of receiving a patent. The cited references clearly fail to disclose such a target.

Further, Applicants respectfully submit that the claimed invention would not have been obvious to one of ordinary skill in the art based solely on the prior art of record. Mathaudhu et al. and Gu et al. fail to disclose anything with respect to sputtering targets; while Rosenflanz et al. merely disclose that "metal alloys or metal oxide sources are formed into a sputtering target(s)".

Still further, Mathaudhu et al. and Rosenflanz et al. fail to disclose a metallic glass sputtering target having an average crystallite size of 1nm to 5nm. Gu et al. is directed to a metallic glass specimen formed by quenching molten metal and then bending the specimen to

form an array of closely spaced shear bands. According to Gu et al., the "regions" extending between "closely spaced" shear bands would be nanocrystalline with particles of an average size of 3nm. However, the specimen would not have a nano-size, ultrafine, uniform structure throughout the entire body of the specimen and therefore would be of no use as a sputtering target which requires a uniform grain size. Thus, even if Mathaudhu et al. was provided with the shear bands and nanocrystalline regions of Gu et al., **the resulting material would not be useful as a sputtering target**.

Accordingly, Applicants respectfully submit that the above cited references fail to fairly disclose to one of ordinary skill in the art the invention required by the claims of the present application. Accordingly, Applicants respectfully submit that the claims of the present application are patentable and are non-obvious over the cited prior art combination of references. Applicants request reconsideration and removal of the rejection for these reasons.

New Claim

New claim 34 has been added. No new matter was added. For example, see page 8, lines 13-17. This claim is added to make clear that the metallic glass sputtering target has a uniform crystal structure throughout the entire target body and that the sputtering target is without shear bands or other bending deformations which would result in non-uniformity of adjacent bands or regions of the target body.

Conclusion

In view of the above amendment and remarks, Applicants respectfully submit that the rejections have been overcome and that the present application is in condition for allowance. Thus, a favorable action on the merits is therefore requested.

Please charge any deficiency or credit any overpayment for entering this Amendment to our deposit account no. 08-3040.

Respectfully submitted,
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